A HISTORICAL PERSPECTIVE ON NETWORK SPINAL ANALYSIS CARE: A UNIQUE INSIGHT INTO THE SPINE'S ROLE IN HEALTH AND WELLBEING

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ABSTRACT

A review of the history of Network Spinal Analysis care, developed by Donald Epstein, reveals a novel understanding of the role of the spine and spinal cord in healthcare. Epstein's unique contributions to functional assessment and applications of the spine and nervous system are explored, as well as broader health related quality of life dimensions. The integration of spinal and neural integrity, with evidence-based functional healthcare, is suggested as a vehicle towards Reorganizational Healing and improved health outcomes. (*Chiropr J Australia 2017;45:304-323*)

Key Indexing Terms: Chiropractic; Stress; Spine; Wellness; Health-Related Quality Of Life.

INTRODUCTION

Understanding the development of Network Spinal Analysis (NSA) care may offer novel insights and clinical options for health care. NSA developed from Network Chiropractic, which originally began as an integration by Donald Epstein of several chiropractic methodologies and theoretical models. [1, 2] Epstein recognized there was a uniqueness to his approach, especially regarding its 'stress busting' effects.[3, 4] He embarked on a multi-decade odyssey of research, application, and refinement of principles and practices. This ultimately gave rise to modern NSA care and the paradigm of Reorganizational Healing. [5-7]

Epstein's clinical protocols evolved through sequenced light touches to the spine, primarily at the ends of the spine in areas where the dura attaches. The protocols and theoretical models originally developed within the context of achieving repeatable phenomenon associated with the clinical application of his work. These phenomena include dissipation of tension from the spinal subsystems, non-local states of consciousness, the emergence of increased quality of life, spontaneous development of wellness lifestyles, increased somatic and self-awareness, and the development of novel reorganizational sensorimotor processes, most notably a respiratory and spinal wave. [17] Each of these elements associated with NSA have potential to impact healthcare.

Epstein proposed that the spine has global and local responses to stress. [3] These responses are predictable and central to anchoring long-term chronic stress within the anatomical structures of the spine. Acute and chronic stress lead to stretching and torquing of the tissues of the spinal cord. [4] This leads to what Breig called adverse

mechanical cord tension (AMCT). [8] Epstein further proposed that AMCT could become embedded into the neurological wiring at a very early age as a form of sensorimotor learning. The spine and spinal cord may remain in a defensive posture for decades, storing energy as tension rather than dissipating it. This perpetuates the chronic stress response and may fixate the individual's sense of self into a narrow range of emotional, psychological, and even spiritual expression. [3, 4]

A unique spinal wave is associated the NSA protocols. [9] It is a repeatable phenomenon demonstrated through clinical observation as well as empirical and qualitative research. The spinal wave may be seen visibly as the spine gently undulates in various ranges of motion. It is also observable with surface electromyography. [10] The wave may create a temporary instability of the tension pattern and act as a reorganizing force in the body. New levels of health and wellbeing are believed to emerge as a result. [6]

Three decades of research and clinical findings related to NSA suggest an important role for the spine in how an individual maintains stability amidst change[11], more readily deals with stress, stays well,[12] and achieves higher levels of living and wellness characterized as Reorganizational Healing. [7, 13] These findings include the dynamics of the spinal wave as a central pattern generator[10], the development of a respiratory wave visibly rocking every vertebra of the spine[14], the stress-busting effect of NSA Care[15-17], and the emergence of increased patient self-reported quality of life with statistically significant impacts on wellness lifestyles. [18, 19]

In order to effectively demonstrate how NSA care may contribute to healthcare, a history of the development of NSA care is required. The protocols and theoretical models, as well as the research and refinements of theory and application over the course of thirty years, point to a very complex topic. Thus, a historical approach was adopted in order to assist the reader to grasp the depth of this work one step at a time. We hope this approach will allow practitioners, researchers, and the lay public to more readily integrate the findings.

DISCUSSION

Emergence of a New Methodology (1982-1986)

In 1982, Epstein recognized that the classic approach to chiropractic vertebral subluxation assessment and spinal adjustment was more complex in its nature and ramifications than previous generations of chiropractors had described. Practitioners trained internationally in Epstein's methodology were encouraged to view the physiological processes of the body as non-linear, multi-directional, and functional. By 1983 Epstein wrote about his initial theories, describing multiple spinal cord tension patterns and started teaching his clinical system in post-graduate programs. [1, 2]

The development of the protocols and theoretical models was driven by the clinical experience of patients. As spinal cord tension patterns were reduced and self-regulated, individuals reported that aspects of the perceived stressful events or trauma were recalled in various somatic, emotional, psychological, and spiritual ways. The body-mind system was observed to revisit prior adaptive, energetic, informational, and structural states. Some of the initial stories of patient responses were documented in the book, *The Twelve Stages of Healing*. [20]

The most profound clinical observation was how individuals developed more energetically resourceful and efficient physical states. This was associated with a net improvement of spinal behavior, posture and alignment, as well new embodied perceptions of the self and environment. It was evident to Epstein that health was a nonlinear phenomenon related to the tension and tone of the spine and spinal cord.

The Spinal Meningeal Functional Unit Tension

In the mid-1980s, Epstein developed the concept of the spinal meningeal functional unit (SMFU) by integrating his clinical findings with Ward's spinal model,[21] Breig's biomechanics of spinal cord tension,[8] and models of neurophysiology influenced by Speransky and Ukhtomsky. [22, 23] The anatomy and physiology of the meningeal system were understood as a critical determinant of health. According to Breig,

> "the spinal canal undergoes considerable changes in length between the extremes of flexion and extension, particularly in the cervical and lumbar regions. The total change is of the order of 5-7 cm, and is greater on the posterior than the anterior aspects. Similarly, on lateral flexion, the canal is lengthened on the convex side and shortened on the concave." [8] (p.11)

Epstein suggested that this type of stretching and torquing of the pons-cord tract may be linked to emotional and chemical stressors, which may 'overload' the neuronal circuitry. This overload adversely changes the meningeal tone and affects the brain and spinal cord. [3] The clinical intervention at this time was developed to dissipate the tension from the spinal cord system. Some of the health outcomes included a global decrease in stress and vigilance for the patient.

Stress and Spinal Posture

Epstein proposed that the forces of physical, chemical, and emotional stress impact posture. Adding these postural changes to gravitational pull increases the pons-cord tract tension. The head moves toward the midline, shoulders go anterior, and in the more pronounced postural adaptations, fists clench and the positioning of the spine and body take on an air of threat or fear.[3]

He introduced a diagram to emphasize the new theory. The spinal cord is depicted as a fishing line being wound up at the cervical spine and hooked at the coccyx. (Figure 1) This also was a way of describing how mechanical forces from elongation of the spine associated with cervical cord tractioning have a significant consequence on lumbar

aggregate tension.[3] According to Breig the tension from the cervical spine was magnified 20-30X in the lumbosacral spine. [8]

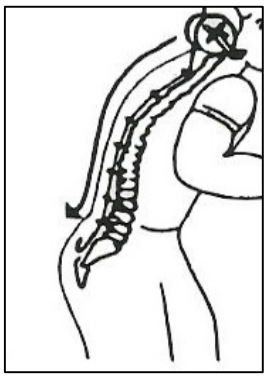

Figure 1. Depiction of spinal cord as a wound up fishing reel hooked at the coccyx. [3]

Epstein hypothesized that the mechanoreceptors and proprioceptors in the cervical spine, which transmit postural information to the brain in relation to head, neck and torso positioning, may be deleteriously affected by pons-cord tract tension. [24] Breig showed that this tension also decreased conductivity of the nerve tissues. [8] This aberrant stretching of the cord's structures could lead to errors in communication within the nervous system. [24] Epstein suggested that this postural response to stress affects information about the relationship between the body and the environment.

Postural distortions related to mechanical loads on the spinal structures in relation to stress and strain on the human frame were found by additional researchers and clinicians as well. [21, 25-27]

Epstein observed that these postural changes are increased by the physiological changes associated with stress, such as adrenal stimulation for increased release of glucose for energy use, increased blood supply to the skeletal muscles, an increase in tension of the tendons as preparation for action, and an increase in metabolic rate. If such a posture continues even after a threat has abated, the dangers of long-term chronic stress and the experience of embodied stress increase. [3]

Additionally, he observed that the longitudinal muscles of the spine become hypertonic. Prolonged hypertonicity in the spinal muscles reveals temporal information about the body's long-term state of stress. Epstein found that it commonly took from four to six months to assist people to reorganize these patterns in the nervous system and begin to develop effective somatic spinal strategies to deal with stress.

Stress Adaptation and Hyper-Vigilance

In 1986 [3], Epstein proposed that the stretching of the cord in response to stress affects the cognitive appraisal of current and future stress adaptation. He writes,

> "The hypothesis presented is that the spinal meningeal functional unit adapts to stress through a precise, reproducible mechanism. The relative degree of tone,

> and its recovery from that tonal quality, of the spinal meningeal functional unit (SMFU) determines the manner of response of the organism, and the degree of cognitive adaptation to stress." [28](p. 58)

When individuals remain in a state of hyper-vigilant posture with indications of intersegmental meningeal tension Epstein noted that the filter, or lens, through which that person views the world is one of competition and threat (even at a low-level long-term stress). [3]

Epstein postulated a spinal learning in relation to the stress response. Feedback between the spinal cord, lower brain, midbrain, and higher cortical centers interact to respond to the threat. This occurs in relationship to the pons-cord tract tension, drawing upon past similar experiences and emotions, and imprinting the current threat/experience for future circumstances. The tension on the SMFU affects the way the person perceives the stimulus of a future threat. This may lead to a nonlinear and deleterious feedback between the individual and the environment. [3]

Epstein suggested that stress occurs when there is a mismatch between the initial response of the spinal system and the cortical interpretation. Depending upon the individual threshold, the converging facilitated SMFU pathways may override effective cognitive and pre-cognitive appraisal. The more the person can draw upon the higher cortical responses to modulate, or effectively condition the lower brain and other more primitive reactions and responses, the more creatively and strategically the individual can negotiate and grow through life's stressors. [3]

This concept was refined in recent years to include available energy and efficiency in the system. The available energy determines the threshold and quality of the response. This is linked to dynamic self-regulation of energy and information.

Pathological Dominance and Stress Patterns in the CNS (1987-1990)

During the next period of development, Epstein integrated findings from the Russian neurophysiology literature along with other interdisciplinary approaches to the body's self-regulation of stress and pain patterns, including Korr's facilitation hypothesis and Sherrington's pluri-segmental discharge model. Theories were integrated with the clinical application and new refinements emerged. All of this led to some novel approaches to the role of stress in the central nervous system, which became the foundation for modern NSA and its potential influence on healthcare. [4, 29, 30]

Palpating for Stress Patterns in the Spinal Musculature

In 1987, Epstein expanded upon his first hypothesis and suggested that viewing the central nervous system as the central mediator of the stress response updates Selye's theory, which emphasized the hormonal system. [4, 22] The CNS develops a set point of postural stress. This is learned from the most severe stress the individual has experienced, habituating the lower brain to a fight or flight type of reaction. Epstein proposed that such reactions require even greater meningeal tension to elicit a similar

reaction to future stimuli. Fear, panic, and crisis may be the end results of this CNS mediated habitual stress response system.

These findings were based in part on the integration of stress into previous chiropractic theory. For example, Homewood wrote, “chiropractic has been concerned with the anatomy of stress, and Dr. Selye with the endocrinology of stress.” [31](p.224) Homewood also noted that structural changes to the spinal musculature after prolonged stress became ‘stringy.’ Epstein would later teach this ropey nature of musculature as a way to palpate for somatic evidence of prolonged emotional overload related to facilitated pathways. [29]

In order to help describe the physiological and anatomical processes of the SMFU in terms of tension, Epstein combined two concepts. [4] The first was Korr’s concept of facilitation of the spinal musculature and the role of the spinal cord in organizing pathological processes. [32-34] This was combined with Sherrington’s concept of plurisegmental discharge resulting from lowered threshold excitatory states. [35] The facilitated musculature remains in an excited state, which responds to low intensity stimulus. From this, Epstein understood an input with low intensity can trigger a very large intersegmental response.

Epstein found that the lowered threshold may be utilized to assist the system to go from lower brain survival functioning to higher cortical awareness of the overall patterns. [4] Thus a new feedback system may develop, one that redirects the cortex in its entire focus. The spinal wave that emerged from Epstein’s protocols was viewed as a new self-regulating feedback system. Once the self-regulation process begins, the higher order awareness is no longer required. The spinal wave begins to oscillate on its own although it can be consciously stopped.

Epstein taught that different connective tissue tension patterns or structural tones in the musculature indicate various types of stressors.[29] The primary structural and muscular tones related to facilitated patterns associated with mental, emotional, and chemical stresses. This evolved into a complex system to analyze, mainly through palpation, for stress physiology as a form of pathological dominance in the CNS. [29] (Figure 2) The SMFU was soon named meningeal subluxation and later facilitated subluxation.[29, 30]

Drawing upon Ukhtomsky’s theory of dominance in the central nervous system, Epstein proposed the body/mind, mediated through the CNS, remembers this state of readiness which may persist for many years. [22, 29]

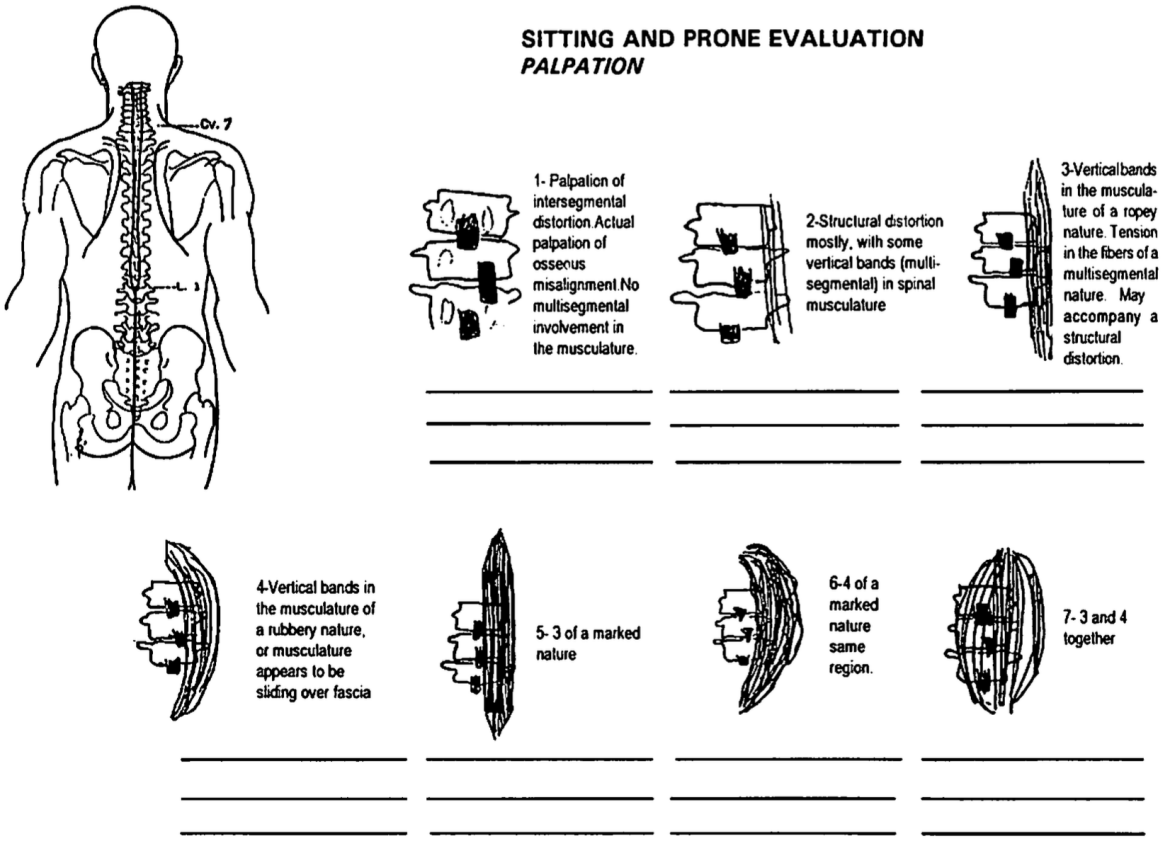

Figure 2. Muscle Palpation for Tension and Tone.[29]

The Spinal Cord and Stress

Epstein proposed a theory of adrenal exhaustion, which establishes an even deeper fixation in the postural response to stress on the spinal cord. [4] The feedback mechanism involved in getting to such a state was integrated with Breig's observations of the contractile nature of collagen fibers, Uktomsky's pathological dominance in the CNS, and Korr's facilitation hypothesis.

Breig observed that not only are the skeletal (postural) muscles made of collagen, but the attachment of the denticulate ligament with the dura mater is a rhomboid collagen network.[8] (Figure 3) The rhomboid network in the pia mater is created by the intersections of fibers along the axial and transverse planes, which affects the directions of elongating, shortening, and kinking the viscous and elastic spinal cord. The epipia is the main structural support for the cord pulp. During transverse or axial traction, the angles of intersections change based on direction. The change in angle results in different vectors of mechanical tension. [8]

Epstein proposed that the release of calcium in the system as a result of other physiological mechanisms of stress causes the collagen fibers to contract even more.[4] Minimal mechanical tension on neurologic structures impairs sensory, motor, and

autonomic function. Severe sustained tension of the meningeal system could predispose the acceleration of pathophysiological processes. [8] Thus, Epstein concluded that the tension increases from stress, which, if not checked by the higher cortical functions, may initiate an even more intense pathological feedback mechanism. [4]

Epstein looked to Speransky's concept of neurodystrophic processes and Korr's facilitation hypothesis to further explain the implications for such irritations to the spinal meningeal functional unit. According to Speransky and Korr, such a state could exist for a very long time without obvious symptomology and remain independent of the original insult.[36, 37]

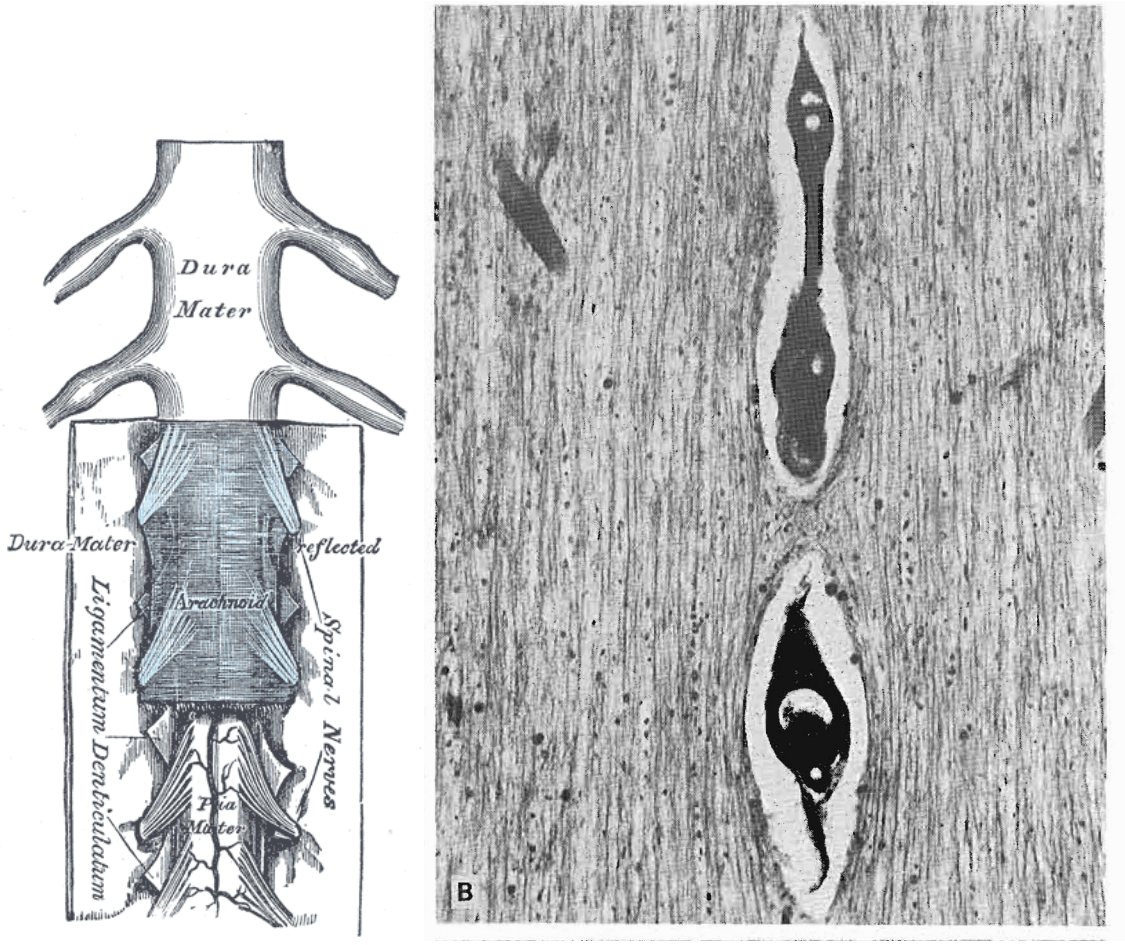

Figure 3. Dura Mater – cord anatomy (from Gray) and Micrograph of a stretched spinal cord coronal section from the cervical cord fixed in situ, with channels containing blood vessels, with the two uppermost channels demonstrating the rhomboid fiber network (reprinted with permission from Michael Shacklock, copyright holder). [38, 39]

Epstein utilized these findings in a clinical setting to establish principles and practices. The results furthered his models and led to increasingly refined protocols and models such as the point of critical tension and the point of facilitated focus. These are

neurological phenomena that could be detected by practitioners to assess for pathological dominance in the CNS.

Critical Tension

Epstein found that the clinical application of a light force touch to the spine dissipated the dominant pathological pattern by recalibrating the nervous system, a process of self-awareness, and release of tension. The more specific this point was the greater the dissipation. Epstein initially explained the concept of critical tension as the point on the spine that responds to the least amount of force, in the proper direction, to reduce the adverse tension on the spinal cord, removing interference to the CNS by decreasing tension on the SMFU. [4] He suggested this may lead to the formation of a more plastic, dynamic, and adaptable CNS.

Due to the heightened threshold of excitability associated with facilitated subluxation, sensory information to the area is not adequately processed. Thus, the area around the point of critical tension is characterized as having lost “awareness” and “self-identity.” [30](p.6) The point of critical tension was proposed as an access point into the CNS.

Facilitated Focus

Epstein proposed that the point of facilitated focus was a place of facilitation in the musculature acting as a pirating mechanism converging the waves of excitation of the dominant defensive pattern into a focused point. [30] This theory integrated the experimental findings of Korr and Uktomsky, the anatomical findings of Breig, with Epstein’s own clinical findings.

The area of facilitated focus is a place of referred tension and energy and is the focus of the adverse tension on the cord. This point of facilitated focus unlike the point of critical tension has a lowered threshold of sensory input because it is “switched ‘on’ consistently.” (p.6) Thus stimulus to this area will cause an exaggerated response and an increase in cord tension. Any additional physical, emotional or chemical stressors to the system will heighten the point of facilitated focus and further elongate and torque the spinal cord, and reinforce the dominant pattern as a central identity. [30, 40]

The facilitated focus is often associated with a presenting symptom. Epstein recognized that the pons-cord tract tension increases with new stressors. He suggested that practitioners use clinical procedures that would not increase pathological dominant patterns by over stimulating this area. This was especially because of the predisposition to alter perception and thus perceive new input through preparedness for fight or flight. [30, 40]

All of these clinical indicators related to stress and adverse mechanical cord tension may be integrated by healthcare practitioners to more fully understand the defense patterns in patients, some of which may be related to other pathophysiological processes.

A Retrospective View of the NSA Spinal Wave

Before continuing the historical perspective on the development of NSA and the unique findings associated with it in terms of health, wellbeing, and personal transformation, it is important to emphasize the distinct spinal wave. All of the subsequent development of Epstein's clinical and theoretical models were driven by the health outcomes associated with the emergence of the wave.

The waves that develop in NSA care are visible oscillations of the spine, which have been objectively and mathematically verified using surface electromyography (sEMG) signals. [41] As the wave progresses during NSA care, it is reminiscent of a central pattern generator (CPG). [42] The network wave may be the first CPG apart from locomotion (walking, swimming) found in the human spine,[10] and demonstrates coherence at a distance. [43]

Oscillation is a frequency of variation between two poles, like the attachments of the spinal cord to the dura on two ends. In-phase oscillation is synchrony between subsystems or within subsystems such as two vertebrae demonstrating coordinated movement. Out of phase oscillation is asynchronous. Oscillation as a factor in biological coordination and thus became central to the development of NSA care. As the wave progresses, a self-organizing signal is detected in the sEMG signal, which grows increasingly coherent and is linked to an increase of frequency entrained spinal oscillators. [9, 44]

Systems Approaches to the Spine System (1995-1996)

During the mid-1990s, Epstein incorporated systems approaches to understanding the spinal and wave dynamics. These approaches included Panjabi's subsystem model of the spine, Holstege's emotional motor system, and Haken and Kelso's models of self-organizing dynamics. This new integration of diverse approaches led to new protocols and an analysis system based on an increasing complexity of spinal and health indicators. These became the hallmark of the NSA levels of care protocols.

Passive, Active, and Neural Control Subsystems

In 1996, Epstein incorporated Panjabi's 3 stabilizing subsystems of the spine into the analysis. [45] The subsystems are defined as passive, active, and neural control. [46] The passive system consists of vertebra, discs, and ligaments. These structures act as transducers to external stressors. The active subsystem consists of muscles and tendons. Muscles provide the forces of stability in the system, while tendons act as signal transducers regarding the magnitude of the forces. [46] The deep muscles of the spine play an important role in defense posture. [47] The muscles act through the neural control subsystem, which receives various input about positioning, stress, load, and forces from the environment. Epstein added the meninges to Panjabi's neural control subsystem[46] by integrating Breig's findings that the meninges act as a passive transducer. [8]

Breig suggested that the pons-cord tract tension exhibits a force dynamic best explained by Saint-Venant's principle.[8] This classic principle derived from mechanical engineering describes elasticity between 2 geometrically short distances. Distribution of stress or load will be weaker the farther apart they become. Pulling on the dura of the cervical spine acts in a similar manner and therefore creates a stretching of the dura in the lumbar spine. [8] More extension of the spine equates with a more relaxed pons-cord tract. [8, 45]

Clinically, practitioners were taught to assess for various indicators demonstrating outcomes for each subsystem.[5] (Figure 4) For example, the passive subsystem will be assessed by palpation of the vertebra for lack of compliance. This may also relate to torquing of the fascia and connective tissue. Increased compliance may indicate greater energy efficiency and information availability. Each system was individually and uniquely assessed for energetic efficiency and integrity.

Assessments
(Recommended)

1. Hard Tissue Palpation
   - **a.** Restriction (ROM)
   - **b.** Fixation (ROM)
   - **c.** Misalignment
   - **d.** Hyper mobility
   - **e.** Postural Shifts
2. Muscle Palpation
3. Phase Indicators
   - **a.** Short Leg Syndrome
   - **b.** Heel Tension
   - **c.** Elevated Leg
   - **d.** Cervical Syndrome
   - **e.** Ankle Aversion Stress
   - **f.** Leg Adduction/Abduction
   - **g.** Z-flick
   - **h.** Leg Crossover (positive ileum)
   - **i.** Sacrotuberous Ligament Tension
   - **j.** Sacral/Thoracic Correlation
   - **k.** Respiration Changes
4. Observation of Respiratory and Somatopsychic Waves
5. Presence/Absence of Available Spinal Gateways
6. Presence/Absence of Spinal Neural Stability Subsystems
7. Presence/Absence of Spinal Frequency Entrained Oscillators
8. Degree of Refinement of Coordination of Spinal/Neural Integrity Subsystems
9. Degree of Refinement of Differentiated Segmental Motion
10. Degree of Awareness of Loss/Gain of Spinal and Neural Stability and Function of Subsystems.

Instrument Assessments
(Optional)

1. Physical (Curve) Analysis
   - **a.** Plumb Line
   - **b.** Photography
   - **c.** Moire Photography
   - **d.** R.O.M. Measuring Devices
   - **e.** Cine Radiography
   - **f.** Bilateral Weight Scales
2. Physiological/Neurological
   - **a.** Temperature Patterns
   - **b.** Imaging
   - **c.** Surface EMG
   - **d.** Biochemical Profiles
   - **e.** EEG

Figure 4. Spinal Assessments for Degrees of spinal and neural integrity and indicators of AMCT. [47]

The Network wave phenomenon demonstrates how the neural subsystem affects adaptive changes in the bony and muscular subsystems, through dissipation of energy and the creation of waves. Epstein proposed that bones and ligaments oscillate and couple to the sensory components of muscles and tendons and connective tissue, which further couple with higher brain centers.

The dissipation of energy is important to spinal stability. When these subsystems are not dissipating energy, the overall system is heading towards a static equilibrium state, which is an entropic loss of subsystem integrity. Greater integrity is found in systems that are far from thermodynamic equilibrium, and therefore more dynamic and adaptable to external conditions.

The Emotional Subsystem of the Spine

Epstein proposed there is a fourth subsystem of spinal stability called the emotional subsystem, which combines the physiology of psychoneuroimmunology with the anatomy of the emotional motor system. [5, 48, 49] Neuropeptides are ubiquitous throughout the body and mediate between the mind, body, and emotion. [50, 51] The dorsal horn of the spinal cord and the brain have large concentrations of neuropeptides. [48, 51, 52] These concepts influenced Epstein to use the term somatopsychic in describing the unique wave process and includes theories from psychoneuroimmunology along with his models of spinal and neural integrity. [48]

The emotional motor system was described by Holstege as diffuse pathways from the limbic system throughout the length of the cord[49, 53], acting as a third motor system, distinct from the somatic motor system and premotor neurons. The diffuse descending systems travel from the limbic system, including the hypothalamus, mesencephalon, amygdala, and the prefrontal cortex, through the spinal cord influencing emotional behaviors, as well as “gain setting systems including triggering mechanisms of rhythmical and other spinal reflexes.” [49] (p.77)

The pathways of the emotional motor system are so diffuse that they do not regulate specific motor movements but rather “they have a more global effect on the level of activity of the motor neurons.” [49](p.69) The projections affect motor neuron excitability and facilitation, locomotion, nociception, lordosis, blood pressure, vocalization, head turning, and pupil dilation.

The impact of the emotional motor system on vocalization is particularly important because it demonstrates how the active and emotional subsystems may dissipate tension through sound. The specific pathway goes from the Limbic system to the Periaqueductal Gray (PAG) to the Nucleus Retroambiguus (NRA), to the motor neurons innervating: abdominal muscles, larynx muscles, pharynx muscles, peri-oral muscles, and mouth opening muscles. [49]

Projections from the mediolateral organization of the limbic system pathways through the brainstem and spinal cord suggest further implications for functional impact in processes as varied as respiration, sympathetic and parasympathetic innervations, as

well as “level setting” of sensory and motor systems in the caudal brainstem and the spinal cord.[49](p.76)

Integration of 4 Spinal Subsystems

Epstein proposed that instability of any of the other 3 spinal subsystems may lead to pathophysiological processes of those specific systems and trigger compensation from the other systems, leading to an impairment of the emotional subsystem. [45]

By including the emotional motor system as part of the emotional subsystem, Epstein linked spinal stability anatomically and physiologically to emotion. Dissipating tension from the emotional system was clinically observable. Indicators included increased respiratory wave and energy release from the passive system to the active system through movement and vocalization. Epstein observed that the vocalizations, which sometimes accompanied the Network wave, dissipate defensive tension from all of the subsystems. [47] This observation suggests a synergy and a depth of interconnectedness within the body, emotions, and mind. [47]

The emotional subsystem is different from the others because it is not associated with a specific location. (Figure 5) Rather, it is a functional system, which is physiologically and anatomically embedded throughout the body.

Epstein proposed that the emotional subsystem tension inhibits effective and efficient distribution and dissipation of emotional energy. The voluntary and involuntary motor systems store the excess tension, which creates a feedback loop. The tension loads carried by the passive, active, and neural control systems overload, which may predispose the individual to injury and illness.

Epstein also proposed that local tension is modulated in conjunction with a restricted range of micro-oscillation of tissues and energy. An increase in this range leads to an increase in emotional experience and expression.[47]

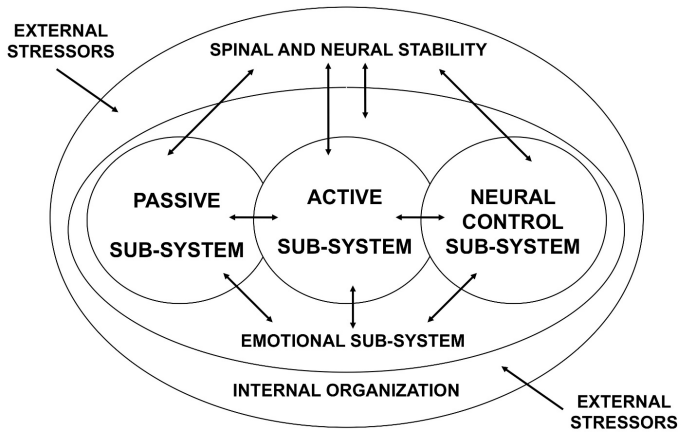

Figure 5. Subsystems Contributing to the Maintenance of Spinal Integrity.[47]

Levels of Care

The NSA care protocol developed into 3 levels of care in 1995. Each level with unique measures of clinical outcomes, as well as self-reported, quality of life indicators. The first level targeted an initial self-regulation of spinal cord tension and the development of a unique spinal respiratory wave, which developed within the initial weeks of care. The second level targeted a development of new emergent somato-spinal strategies, which are characterized by dissipation of energy and the formation of 2 entrained spinal oscillators The third level focused on higher level strategies associated with wellness, growth and three entrained spinal oscillators. Questionnaires were designed for each level of care to allow the individuals to document any changes in somatic awareness and overall quality of life.[6]

Epstein proposed that each level of care is associated with new baselines of higher order states. Each dominant pattern of defense exists in a narrow threshold of energy keeping the defense system in existence. As these thresholds are exceeded and bound energy gets redistributed, the need or ability to reproduce the experience of stress as a linked behavioral, structural and perceptual system may no longer be necessary. The more energy efficient states are more plastic and better able to adapt to the environment and replace the dominant patterns of defense.

Wellness Lifestyles and Social Science Research on NSA care (1994-2004)

In 1994, a concerted effort to document the social science components of health and wellness benefits of the care was undertaken. The unique sensorimotor and wellness phenomenon associated with Network care led to a wellness survey instrument. The instrument was developed to characterize, a “wellness coefficient.” The survey instrument was based on a combined wellness scale including 4 domains of health: physical state, mental/emotional state, stress evaluation, life enjoyment, as well as overall quality of life. (Figure. 6) The instrument was designed and applied in a retrospective format, for patients to self-rate wellness prior to Network Care and ‘presently.’

The retrospective study of 2,818 people demonstrated a clearer picture of the socio-demographic characteristic of the population base as well as positive significant changes in each domain studied including an improved wellness coefficient of perceived change in over 76% of respondents. Wellness coefficients improved from as early as 1-3 months of care, and extend into 3 years or more, demonstrating no ceiling to the wellness benefits. This retrospective study along with the follow-up longitudinal study demonstrated the unique wellness indicators associated with NSA Care, all of which point to a “greater capacity to cope with stressful situations,” [18](p.2), or a stress “busting” effect. [14, 18, 19, 54, 55]

One important impact of this research on the subsequent development of NSA care protocols was the finding that factors regarding NSA care (duration of care, awareness of the respiratory wave, and awareness of the spinal wave) [19] were predictors of increased quality of life and a higher wellness coefficient. Additionally, the longer an

individual was in care and the greater awareness of the spinal wave, the higher the levels of wellness that were self-reported. [6, 18, 19] These relationships were explored through structural equation modeling, demonstrating that NSA care is a predictor of improved wellness lifestyle choices, which demonstrated a different pathway to wellness from lifestyle choices alone. [19]

Self-Rated Health Scales: The following domains and items were used to assess health, wellness and overall quality of life.

I. Physical State

"Rate the following questions on a frequency scale of 1 to 5, with 1 = never, 2 = rarely, 3 = occasionally, 4 = regularly, 5 = constantly."

1. Presence of physical pain (neck/back ache, sore arms/legs etc.)
2. Feeling of tension or stiffness or lack of flexibility in your spine.
3. Incidence of fatigue or low energy.
4. Incidence of colds and flu.
5. Incidence of headaches (of any kind).
6. Incidence of nausea or constipation.
7. Incidence of menstrual discomfort.
8. Incidence of allergies or eczema or skin rashes.
9. Incidence of dizziness or lightheadedness.
10. Incidence of accidents or near accidents or falling or tripping.

II. Mental/Emotional State

"Rate the following questions on a frequency scale of 1-5, with 1 = never, 2 = rarely, 3 = occasionally, 4 = regularly, 5 = constantly."

1. If pain is present, how distressed are you about it.
2. Presence of negative or critical feelings about yourself.
3. Experience of moodiness or temper or angry outbursts.
4. Experience of depression or lack of interest.
5. Being overly worried about small things.
6. Difficulty thinking or concentrating or indecisiveness.
7. Experience of vague fears or anxiety.
8. Being fidgety or restless; difficulty sitting still.
9. Difficulty falling or staying asleep.
10. Experience of recurring thoughts or dreams.

III.Stress Evaluation

"Evaluate your stress relative to the following, with 1 = none, 2 = slight, 3 = moderate, 4 = pronounced, and 5 = extensive."

1. Family.
2. Significant Relationship.
3. Health.
4. Finances.
5. Sex Life.
6.Work.
7. School.
8. General well-being.
9. Emotional well-being.
10. Coping with daily problems.

IV.Life Enjoyment

"Rate the following questions on a degree scale of 1-5, with 1 = not at all, 2 = slight, 3 = moderate, 4 = considerable, 5 = extensive."

1. Openness to guidance by your "inner voice/feelings."
2. Experience of relaxation or ease or well-being.
3. Presence of positive feelings about yourself.
4. Interest in maintaining a healthy lifestyle (e.g., diet, fitness, etc.).
5. Feeling of being open and aware/connected when relating to others.
6. Level of confidence in your ability to deal with adversity.
7. Level of compassion for, and acceptance of, others.
8. Satisfaction with the level of recreation in your life.
9. Incidence of feelings of joy and or happiness.
10. Level of satisfaction with your sex life.
11.Time devoted to things you enjoy.

Overall Quality of Life (Woodruff and Conway, 1992)

"Evaluate your feelings relative to the quality of your life with 1 = terrible, 2 = unhappy, 3 = mostly dissatisfied, 4 = mixed, 5 = mostly satisfied, 6 = pleased, 7 = delighted."

1.Your personal life.
2.Your wife/husband or (significant other).
3.Your romantic life.
4.Your job.
5.Your co-workers.
6.The actual work you do.
7.Your handling of problems in your life.
8.What you are actually accomplishing in your life.
9.Your physical appearance - the way you look to others.
10.Your self.
11.The extent to which you can adjust to changes in your life.
12.Your life as a whole.
13. Overall contentment with your life.
14.The extent to which your life has been what you wanted it to be.

Figure 5. Self-Rated Health Scales.[18]

The wellness outcomes associated with the Network wave suggest that a spinal Reorganizational Healing phenomenon is occurring. [7, 56] The technology and mathematical analysis developed to measure the increasing coherence of the electromagnetic signal associated with the Network spinal wave may one day be used as part of the neurological suite.[9] We have proposed that these phenomena associated with NSA care suggests an endogenous reorganizational system.[41]

An endogenous reorganizational system in the body may exist on the functional edge between the stress system and the relaxation system.[41] This reorganizational system may be mediated by the spinal stabilizing subsystems and linked to innate pathways of the body to 'break-out' of stuck and defensive patterns and emerge or reorganize wellbeing.

CONCLUSION

Over the course of 30 years, Epstein developed the NSA protocols and a new functional perspective on the spine, which included its role in stress, health, and reorganizational wellbeing. Starting as in integration of several models of chiropractic applications, the clinical outcomes led to an integration of several disciplines such as the osteopathic literature on facilitation, the spinal cord research of Breig, the Russian neurophysiology inspired by Speransky and Ukthomsky, Panjabi's subsystem model, as well as other systems approaches from Kelso to Pert and anatomical models such as Holstege. The integration of these many diverse fields in clinical practice led to a robust research agenda, which continues to produce a body of work that is unique and demonstrates important applications to healthcare.

Future research to explore this phenomenon could emphasize the role of the spinal cord in oscillation, brain responses, and overall changes in each individual's life as it relates new and emergent levels of health in relation to stress responses.

The many developments described in this article further evidence the relation of the spine and nervous system to overall health and wellbeing, as valuable in evidence based chiropractic and healthcare practice.

Disclosure Statement

No competing financial interests exist.

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